

Lighting and visual environment engineering essay

[Engineering](#)



**ASSIGN
BUSTER**

NT1030 Building Services Engineering Science Research the properties of light. Within your work you should discuss how light is produced, how different colours are produced and how light travels. Light is a form of radiant energy or electromagnetic energy that travels in waves made up of vibrating electric and magnetic fields. These waves of energy have both a frequency and a length, the frequency and length of these waves distinguish visible light from the other forms of energy detailed on the electromagnetic spectrum. Light always travels in a straight line at a speed of around 300,000,000 meters/second in a vacuum. The speed of light does differ when travelling through matter, for example when travelling through water the speed of light is around $\frac{3}{4}$ of the speed in a vacuum. Light visible by humans represents only a narrow band between the invisible ultraviolet light (UV) which has shorter wave lengths and infrared energy (heat) which has longer wave lengths. The visible light spectrum has wave lengths from around 380nm to 740nm. The colour of visible light is determined by the frequency and the amount of energy in a light wave. For example a blue light wave has more energy than a red light wave. As the energy increases so does the frequency, and proportionally as the frequency increases the wavelengths get shorter. So a blue light wave has a much shorter wavelength and higher frequency than that of a Red light wave. We could think of light in terms of photons. Light photons are produced from atoms. When an atom is energized the electrons which orbit the nucleus move to a higher orbit. Atoms do not like having electrons in higher than normal orbit. Photons are produced when electrons located in an abnormal higher orbit drop back to their preferred normal orbit. The frequency or color of this photon is directly proportional to the distance the electron falls from its higher orbit to its lower

<https://assignbuster.com/lighting-and-visual-environment-engineering-essay/>

orbit. Neon signs, Fluorescent lamps and sodium lamps are some examples of electric lighting which exploits this phenomenon to produce light. An electrical current is passed through a gas or material which excites the electrons. This causes the atoms in the gas to produce photons of light energy and so the gas emits light. Gas-discharge lamps use many different gases and the colors they emit vary hugely depending on the type or mixture of the gas used in the construction of the lamp. For example It is easy to identify a sodium vapor light because the light emitted is yellow. A sodium vapor light works by energizing sodium atoms which produce and generate photons. Because of the way electrons are stacked in sodium atoms a particular one of its 11 electrons is most likely to accept and emit energy. The energy level of this electron which moves orbit to produce the photons is proportional to the energy required to produce a wavelength of 590 nanometers. Wavelengths of around 590nanometers correspond to yellow light. If you were to refract sodium light through a prism, you wouldn't see a rainbow like you would with white light-- you see a pair of yellow lines. Light can be reflected, scattered, absorbed and refracted. Discuss how these properties can be used by designers when designing property to assist in improving thermal comfort. When light comes it to contact with matter several things can happen, the light can: -ScatterReflectBendBe AbsorbedBe TransmittedScattering (random) or Reflecting (in an organized direction) = when the light is bounced backPretty much everything you see is reflected light. We see because light reflects off objects and into our eyes. An example of reflecting light is the moon. When we see it glowing at night what we are seeing is light from the sun reflecting off the Moon's surface, and bouncing back making it glow. A Scattering reflection of light would occur on a rough

<https://assignbuster.com/lighting-and-visual-environment-engineering-essay/>

surface such as if your car or jewellery has not been polished for a while.

Absorption = when light is absorbed and not bounced back. Light stops at the object and does not reflect or refract. Objects appear dark or opaque.

Example: wood. Transmission = whenever light goes through something that is transparent. Transmission or Refraction occurs when light goes through the object and bends at an angle. Example: diamond (greater angle of refraction) or water (lesser angle of refraction).

These principles of the behaviour of light can be used by designers to improve building performance, thermal comfort and energy performance. The principles of absorption and reflection can be manipulated to cool or heat a building. By using different building materials and surface finish colours, altering the building aspect and specifying suitable glazing, light energy can either be absorbed into a thermal mass; which would then radiate heat into the building or similarly reflect off the building to ensure heat gain of the building is kept to a minimum. Preventing excessive solar heat gain during the afternoon can sometimes be more important than gaining natural light especially in warmer climates. When thermal comfort is a priority sun shades or shutters could be used to prevent the sun's heat from getting inside the room. Passive thermal comfort can be improved as a direct result of reducing lighting energy. This is because saving light energy will also reduce the amount of cooling energy required. Some electrical energy used by a building's lighting system turns in to heat that needs to be removed from that room. Some of this heat is from the inefficiency of the lighting equipment and the rest is emitted from when light converts to heat having been absorbed by the materials which the light illuminates. Discuss how the use of natural light can be used to improve the sustainability of buildings providing examples where appropriate. Around <https://assignbuster.com/lighting-and-visual-environment-engineering-essay/>

25% of a commercial buildings energy bills is spent on Lighting. Lighting is powered by power generation plants burning fossil fuels which are the main producers of a significant percentage of carbon dioxide emissions and a leading cause of climate change. Due to this, the building industry has identified lighting as a key element in sustainable design, and now there is a huge movement to implement and develop lighting systems that meet with users needs and concerns, and address environmental regulations.

Natural daylight is the most sustainable lighting source. Not only is it a free & renewable resource but the health benefits have also been well-documented. An architect's careful design is required to maximise natural light in a building while reducing direct light glare and maintaining indoor temperatures. Good natural lighting design is achieved by placing windows, skylights, light shafts, atriums and translucent panels strategically in harmony with other building components, such that light is reflected evenly throughout internal spaces so they make best use of any available natural light. Sunlight transportation is an emerging new technology. Fibre optic cables collect Natural sunlight on roof panels and transport it into a building, this light can be transported for distances of up to 15 metres. Solar panels and Sunlight-piping systems can be used in combination to integrate natural and artificial light systems.

Describe and carry out practical measurements to determine the average Daylight Factors (DF) on the working plane in three locations throughout the college and compare the readings to those stated in industry guides. Natural lighting received into a building usually only accounts for a small proportion of the required amount of light – this is due to sizing of windows and

openings and will also constantly change because of the influences imposed on the whole sky. Illumination level are affected by clouds, surrounding buildings and/or other reflecting planes. Therefore, it is not practicable to express day lighting inside a building in terms of the illumination obtained inside a building at any one time. This is because any figure obtained is liable to change within short periods of time and directly effected by changes in the sky luminance. The daylight factor is used for practical purposes. This is a ratio (%) of the illumination level at a given point or working plane inside a room compared to the illumination levels outside in an un-shaded position. Three readings were taken in different work plane locations of our classroom area during the day. These readings were: 400, 380 & 325. We can take an average for the room using these reading = 368. $3\text{LuxDF} = (E_i \div E_o) \times 100$ where: DF = Daylight factor E_i = Illuminance at reference point in building E_o = Illuminance at the reference point if the room was unobstructed E_i and E_o are measured in lux (lumens per square metre) and E_o is based on the standard average of 5000 lux for unobstructed sky in the UK. (CIBSE lighting Guide, LG05). For a daylit appearance without any electric lighting, the average daylight factor should not be less than 5 percent. So the Daylight Factor for the room would be: According to BS 8206 "... the average daylight factor should be at least 2%. If the average daylight factor in a space more than 5% then electric lighting is not normally needed during the daytime, provided the uniformity is satisfactory." Other recommendations or standards for daylight factors are as follows: -Carbon Trust / BSF: Daylight factor not less than 4%. Preferably 6%. BREEAM: Where at least 80% of occupied spaces will be adequately daylit with an average daylight factor exceeding 2% BREEAM: Where all spaces will be adequately

<https://assignbuster.com/lighting-and-visual-environment-engineering-essay/>

daylit with an average daylight factor exceeding 4% in single storey and 3% in multi-storey buildings. Daylight factor can be given either as a value at a specific point or as an average over a defined area like a room (Littlefair, 1991; Littlefair, 1995, Littlefair and Aizlewood, 1999). This means that from the measurements we took in our class room the daylight factor was in line with CIBSE recommendations, I believe this was due to good design of the glazed windows.